

We claim:

1. A method of preparing an enedialkylidene complex, comprising:
  - (a) combining a terminal alkyne with a first transition metal complex to give a second transition metal complex; and
  - (b) treating the second transition metal complex with a base.
2. The method of claim 1, wherein the terminal alkyne is an alpha, omega-dialkyne.
3. The method of claim 1, wherein the first transition metal complex comprises a Group VI transition metal.
4. The method of claim 3, wherein the Group VI transition metal is Mo or W.
5. The method of claim 3, wherein the Group VI transition metal is Mo.
6. The method of claim 1, wherein the first transition metal complex has the formula  $X_3MX'$ , wherein

$X$  is independently for each occurrence a  $\sigma$ -bond ligand;

$M$  is a Group VI transition metal; and

$X'$  is chloride, bromide or iodide.

7. The method of claim 6, wherein  $L$  is independently for each occurrence  $-N(R)_2$ , and  $R$  is independently for each occurrence H, alkyl, aryl, aralkyl, cycloalkyl, bicycloalkyl, or tricycloalkyl.
8. The method of claim 7, wherein  $X$  is  $-N(i\text{-Pr})(3,5\text{-Me}_2C_6H_3)$ .
9. The method of claim 6, wherein  $X'$  is I.
10. The method of claim 6, wherein  $M$  is Mo or W.
11. The method of claim 6, wherein  $M$  is Mo.
12. The method of claim 6, wherein  $X$  is  $-N(i\text{-Pr})(3,5\text{-Me}_2C_6H_3)$ ,  $M$  is Mo, and  $X'$  is I.
13. A method of preparing an enediyne or an alkyne metathesis catalyst or both, comprising

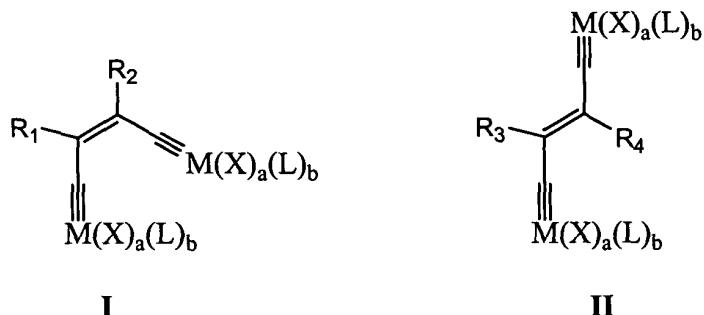
the step of reacting an alkyne with an enedialkylidyne complex, thereby forming an enediyne or an alkyne metathesis catalyst or both.

14. The method of claim 13, wherein the enedialkylidyne complex comprises a Group VI transition metal.

15. The method of claim 14, wherein the Group VI transition metal is Mo or W.

16. The method of claim 14, wherein the Group VI transition metal is Mo.

17. The method of claim 13, wherein the enedialkylidyne complex has formula I or II:



wherein, independently for each occurrence:

M is a Group V, VI, VII, or VIII transition metal;

X is a  $\sigma$ -bonded ligand;

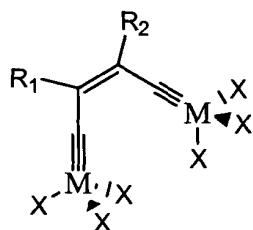
L is a donor bonded ligand;

R<sub>1</sub>, R<sub>2</sub>, R<sub>3</sub>, and R<sub>4</sub> are H, or optionally substituted alkyl, aryl, and aralkyl; or R<sub>1</sub> and R<sub>2</sub> are covalently bonded to each other to form a 4-20 membered ring;

a is an integer from 1 to 3 inclusive; and

b is an integer from 0 to 4 inclusive.

18. The method of claim 17, wherein the enedialkylidyne complex has formula III:



### III

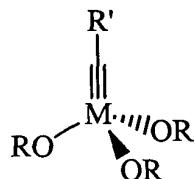
wherein, independently for each occurrence:

X is a  $\sigma$ -bond ligand;

M is a Group VI transition metal; and

R<sub>1</sub> and R<sub>2</sub> are H, or optionally substituted alkyl, aryl, and aralkyl; or R<sub>1</sub> and R<sub>2</sub> are covalently bonded to each other to form a 4-20 membered ring.

19. The method of claim 18, wherein X is independently for each occurrence -OR, and R is independently for each occurrence alkyl, aryl, aralkyl, cycloalkyl, bicycloalkyl, or tricycloalkyl.
20. The method of claim 19, wherein R is independently for each occurrence selected from the group consisting of 2-methylphenyl, 2-phenylphenyl, 2,6-diphenylphenyl, 1-adamantanyl, 2-trifluoromethyl-2-propyl, and t-butyl.
21. The method of claim 18, wherein M is independently for each occurrence Mo or W.
22. The method of claim 18, wherein M is Mo.
23. The method of claim 18, wherein R<sub>1</sub> and R<sub>2</sub> form a six-membered ring.
24. The method of claim 18, wherein X is -O-adamantanyl, M is Mo, and R<sub>1</sub> and R<sub>2</sub> form a six-membered ring.
25. The method of claim 18, wherein the alkyne metathesis catalyst has formula IV:



IV

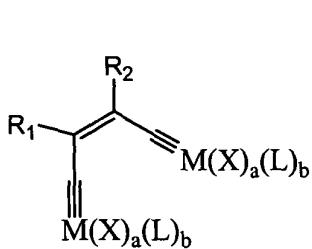
wherein

M is a Group VI transition metal;

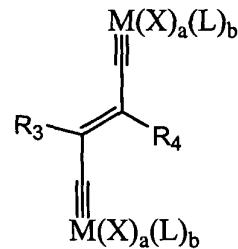
R is independently for each occurrence H, alkyl, aryl, aralkyl, cycloalkyl, bicycloalkyl, or tricycloalkyl; and

R' is optionally substituted alkyl or optionally substituted aryl.

26. The method of claim 25, wherein M is Mo or W.
27. The method of claim 25, wherein M is Mo.
28. The method of claim 25, wherein R is independently for each occurrence selected from the group consisting of 2-methylphenyl, 2-phenylphenyl, 2,6-diphenylphenyl, 1-adamantanyl, 2-trifluoromethyl-2-propyl, and t-butyl.
29. The method of claim 25, wherein M is Mo, and R is independently for each occurrence selected from the group consisting of 2-methylphenyl, 2-phenylphenyl, 2,6-diphenylphenyl, 1-adamantanyl, 2-trifluoromethyl-2-propyl, and t-butyl.
30. A method of catalyzing an alkyne metathesis reaction, comprising combining an alkyne with an enedialkylidyne represented by formula V or VI:



V



VI

wherein, independently for each occurrence:

M is a Group V, VI, VII, or VIII transition metal;

X is a  $\sigma$ -bonded ligand;

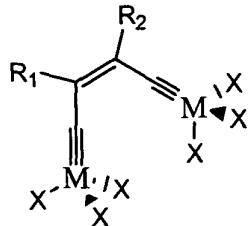
L is a donor bonded ligand;

$R_1$ ,  $R_2$ ,  $R_3$ , and  $R_4$  are H, or optionally substituted alkyl, aryl, and aralkyl; or  $R_1$  and  $R_2$  are covalently bonded to each other to form a 4-20 membered ring;

a is an integer from 1 to 3 inclusive; and

b is an integer from 0 to 4 inclusive.

31. The method of claim 30, wherein the enedialkylidyne complex has formula VII:



**VII**

wherein, independently for each occurrence:

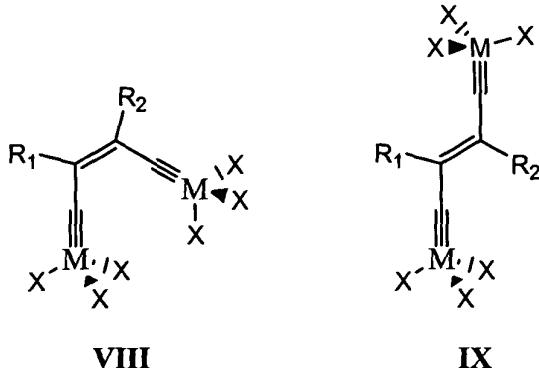
X is -OR;

R is alkyl, aryl, aralkyl, cycloalkyl, bicycloalkyl, or tricycloalkyl;

M is a Group VI transition metal; and

R<sub>1</sub> and R<sub>2</sub> are H, or optionally substituted alkyl, aryl, and aralkyl; or R<sub>1</sub> and R<sub>2</sub> are covalently bonded to each other to form a 4-20 membered ring.

- 32. The method of claim 31, wherein R is independently for each occurrence selected from the group consisting of 2-methylphenyl, 2-phenylphenyl, 2,6-diphenylphenyl, 1-adamantanyl, 2-trifluoromethyl-2-propyl, and t-butyl.
- 33. The method of claim 31, wherein M is independently for each occurrence Mo or W.
- 34. The method of claim 31, wherein M is Mo.
- 35. The method of claim 31, wherein R is independently for each occurrence selected from the group consisting of 2-methylphenyl, 2-phenylphenyl, 2,6-diphenylphenyl, 1-adamantanyl, 2-trifluoromethyl-2-propyl, and t-butyl; and M is Mo.
- 36. A method of activating an enedialkylidyne complex for metathesis, wherein the enedialkylidyne complex comprises at least one  $\sigma$ -bonded amine ligand, comprising reacting the enedialkylidene complex with an alcohol to form at least one  $\sigma$ -bonded alkoxy ligand.
- 37. An enedialkylidyne complex having formula **VIII** or **IX**:



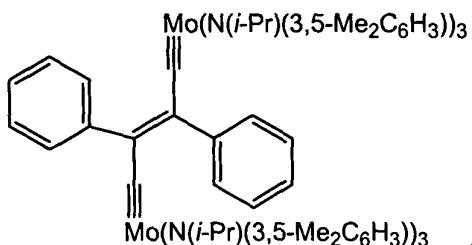
wherein, independently for each occurrence:

M is a Group VI transition metal;

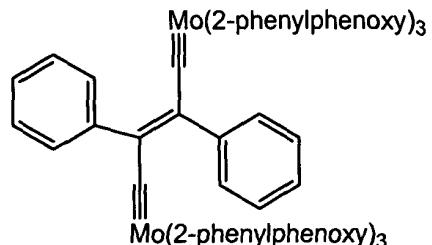
X is a  $\sigma$ -bonded ligand;

R<sub>1</sub> and R<sub>2</sub> are H, or optionally substituted alkyl, aryl, and aralkyl; or R<sub>1</sub> and R<sub>2</sub> are covalently bonded to each other to form a 4-20 membered ring.

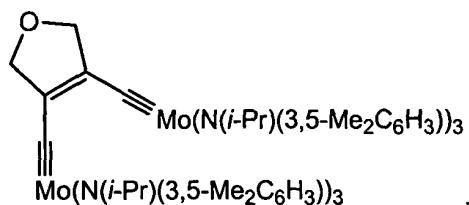
38. The compound of claim 37, wherein M is a Mo or W.
39. The compound of claim 37, wherein M is Mo.
40. The compound of claim 37, wherein X is -OR, wherein R is independently for each occurrence alkyl, aryl, cycloalkyl, bicycloalkyl, or tricycloalkyl.
41. The compound of claim 37, wherein X is -N(R)<sub>2</sub>, wherein R is independently for each occurrence H, alkyl, aryl, cycloalkyl, bicycloalkyl, or tricycloalkyl.
42. The compound of claim 37, wherein X is -N(i-Pr)(3,5-Me<sub>2</sub>C<sub>6</sub>H<sub>3</sub>).
43. The compound of claim 37, wherein R<sub>1</sub> and R<sub>2</sub> are covalently bonded to each other to form a 4-20 membered ring.
44. The compound of claim 37, wherein the compound is



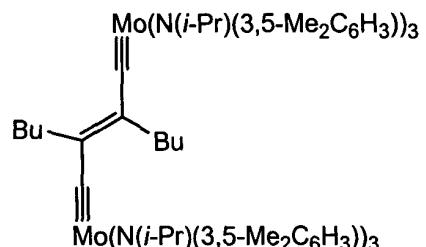
45. The compound of claim 37, wherein the compound is



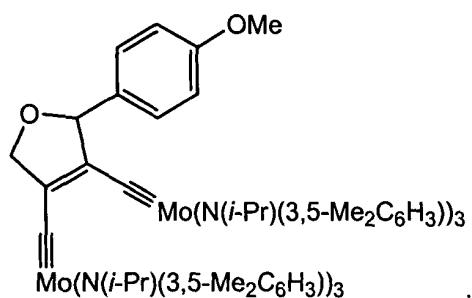
46. The compound of claim 37, wherein the compound is



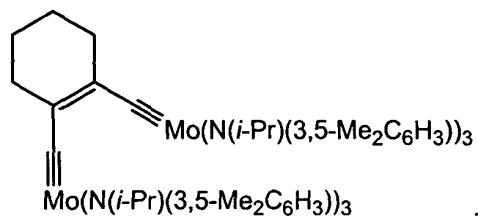
47. The compound of claim 37, wherein the compound is



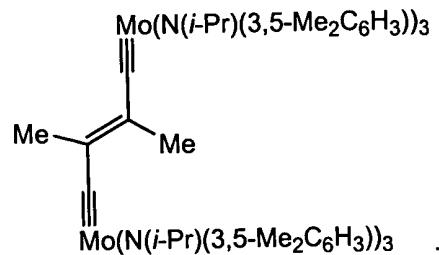
48. The compound of claim 37, wherein the compound is



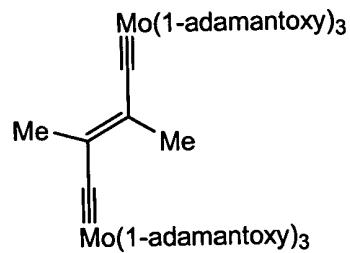
49. The compound of claim 37, wherein the compound is



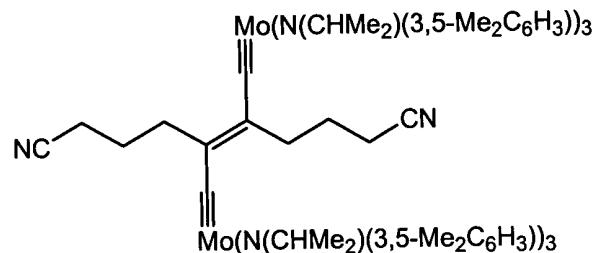
50. The compound of claim 37, wherein the compound is



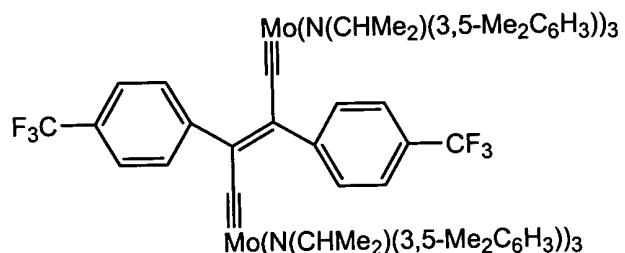
51. The compound of claim 37, wherein the compound is



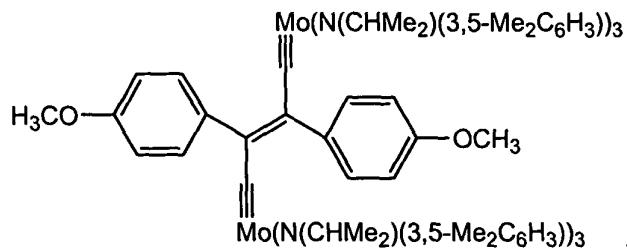
52. The compound of claim 37, wherein the compound is



53. The compound of claim 37, wherein the compound is



54. The compound of claim 37, wherein the compound is



55. The compound of claim 37, wherein the compound is

